



Fluttering Fun, Point of Balance

LESSON THEME

To learn an object's center of gravity and how it can be changed.

OBJECTIVES

The students will:

- investigate the concept of center of gravity
- determine the center of gravity of a two-dimensional object by balancing it on the top of a pencil
- change the center of gravity of a two-dimensional object by adding paper clips and balancing it on the top of a pencil

NASA SUMMER OF INNOVATION

UNIT

Physical Science - Aeronautics

GRADE LEVELS

4th – 6th

CONNECTION TO CURRICULUM

Science, Mathematics, and Technology

TEACHER PREPARATION TIME

1 hour

LESSON TIME NEEDED

1 hour Complexity: Basic

NATIONAL STANDARDS

National Science Education Standards (NSTA)

Science as Inquiry

- Understanding of scientific concepts
- An appreciation of 'how we know' what we know in science
- Understanding of the nature of science
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities, and attitudes associated with science

Physical Science Standards

- Motions and forces
- Transfer of energy

Science and Technology Standards

- Abilities of technological design
- Understanding about science and technology

History and Nature of Science Standards

- Science as a human endeavor

Common Core State Standards for Mathematics (NCTM)

Operations and Algebraic Thinking

- Use the four operations with whole numbers to solve problems
- Generate and analyze patterns

Operations and Algebraic Thinking

- Analyze patterns and relationships
- Write and interpret numerical expressions
- Analyze patterns and relationships

ISTE NETS and Performance Indicators for Students (ISTE)

Creativity and Innovation

- create original works as a means of personal or group expression

- use models and simulations to explore complex systems and issues
- Communication and Collaboration*
- contribute to project teams to produce original works or solve problems

Research and Information Fluency

- plan strategies to guide inquiry
- process data and report results

Critical Thinking, Problem Solving, and Decision Making

- identify and define authentic problems and significant questions for investigation
- plan and manage activities to develop a solution or complete a project
- collect and analyze data to identify solutions and/or make informed decisions

Technology Operations and Concepts

- understand and use technology systems
- select and use applications effectively and productively
- troubleshoot systems and applications

MANAGEMENT

There is no student data sheet. This activity does not use the scientific method, but employs trial and error. It could be improved by using strategies and simple mechanical ways (the strategies and techniques listed in finding the center of gravity using rulers and plumb lines).

A student data table should list independent variables and the dependent variable, and contain a table for data collection.

CONTENT RESEARCH

Key Concepts

- **Center of Gravity** – The point in an object about which the object's weight is centered.
- **Weight and Balance:** A term referring to the distribution of weight in an aircraft and the location of its center of gravity. The center of gravity is the point where the weight is balanced. Proper weight and balance are essential for the safe operation of an aircraft.
- **Center of Pressure:** (the other "center") The point on the surface of an object about which the object's surface area is centered. Half of the total air pressure is on one side of the point and half on the other.

MATERIALS

- Butterfly pattern
- Construction paper
- Pencil with a flat eraser
- Modeling clay
- Scissors
- Paper clips
- Science journal

LESSON ACTIVITIES

Determine the Center of Gravity for the butterfly pattern.

http://scifiles.larc.nasa.gov/docs/guides/guide4_00.pdf

ADDITIONAL RESOURCES

Exploring the Extreme Educator Guide

<http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Exploring.the.Extreme.Guide.html>

- Finding the Center of Gravity Using Rulers (K – 4)
- Finding the Center of Gravity Using Plumb Lines (K – 4)
- Changing the Center of Gravity Using Moment Arms (K – 4)
- Center of Gravity, Pitch, Yaw (5 – 8)

DISCUSSION QUESTIONS

What is the center of gravity? *The center of gravity is the point where the weight is balanced. Point through which the force of gravity acts and about which the airplane is balanced.*

How can you determine the center of gravity of a two-dimensional object? *Move the object around until it balances on the top of the pencil.*

How you change the center of gravity of a two-dimensional object? *Add paper clips and then move the object around until it balances on top of the pencil.*

ASSESSMENT ACTIVITIES

- Different animal and aircraft shapes to determine center of gravity.
- Add paper clips to change the center of gravity in the different animal and aircraft shapes to determine the change in the center of gravity.

ENRICHMENT

- Use thicker paper or cardboard and see how it affects the center of gravity.
- Dangle the paper clips from the wings instead of attaching them firmly.
- Explore other techniques for determining the center of gravity.
 - Rulers
 - Plumb Lines
- Explore other techniques for changing the center of gravity.
 - Moment Arms